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MULTICHIP MODULE
HIGH SPEED TESTING

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Quarterly Progress Report
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Progress for the period January 1, 1994 - March 31, 1994 is described below, in the areas of the electrooptic testing of multichip modules.

Electrooptic Testing using Electrooptically Active Polymers

One problem we have characterized is the degradation of the poled polymer due to high visible light intensities. Our low signal-to-noise ratios in the experiment have led us to increase the incident optical intensity on the polymer; however, at light intensities of approximately 10 mW (632 nm HeNe) we observe a degradation of the signal over minutes of time (see Fig. 1). Since the material could not be repoled by heating it to the glass transition temperature (132° C) under voltage, we conclude that the signal loss is not due to depoling or bleaching of the polymer but rather to the photon-induced or thermal decomposition of the material. This is consistent with the fact that optical absorption in the polymer rises rapidly with wavelength in the visible region. We have not noticed such signal degradation at 780 nm wavelengths, but the optical power available to us at that wavelength is lower (5 mW maximum). We are planning to investigate wavelengths in the 700 nm region which should reduce the degradation effects but still permit visible optical alignment.

Dan Schwab of the Mayo Foundation has recently loaned us a multichip module coupon (Honeywell) for PMMA:MA1 copolymer testing on microstrip transmission lines. Dr. David Tuckerman of nChip estimates for typical such geometries that we can expect fringing fields that are 10-15% of the maximum field strength under the microstrip; on this basis, an estimate of our signal-to-noise ratio suggests that signal averaging will be necessary in such a geometry. However, since the applied polymer layer will probably increase the field outside the microstrip dielectric layer, higher fields in the electrooptic material might be expected. We are currently working on these issues.

a-Si:H Photodetector Fabricated on an Optical Fiber

Recently, we demonstrated a photoconductive photodetector on a fiber (manuscript in preparation). Two problems we have identified with the first devices are 1) an anomalously long signal decay time in some, but not all, testing situations, and 2) efficiency degradation over periods of time. Both of these appear to be related to the nature of the amorphous hydrogenated silicon material. Under high photon fluence such material often exhibits poorly understood persistent photoconductivity (PPC) effects, which lead to very long (1 msec) photoconductive decay times. Also, photo-assisted degradation of the films (the Staebler-Wronski effect) appears to limit the optical power allowable for testing. In both cases, it will be necessary to lower the optical power incident on the devices.

Since coupling of the photoconductors to the core region of the fiber needs to be increased, we have also investigated the wet etching of selected fiber sections. Since the fibers are ~ 100 microns wide, photolithography is not practical, due to photoresist coverage and depth of focus problems. One effective technique we have developed involves 1) the coating of a fiber section in wax; 2) the removal of a section of wax with a thin blade; and 3) the immersion of the masked fiber into 30% HF and water. The etch rate is approximately 0.30 microns/min and reasonably reproducible, and yields an etched region on one side of the fiber only of approximately 1000 microns wide. The etched region also has sloped sidewalls which should not yield conformal coverage problems with typical thin film deposition techniques.

Travel

Robert J. Davis attended the ARPA Electronic Packaging program review in Marina Del Ray, CA in February, and also visited the Hughes Research Laboratory in Malibu, CA to discuss electrooptic testing. He also attended the 1994 IEEE Multichip Module Conference in Santa Cruz, CA in March.

Intellectual Property

A patent application entitled *Thin Film Structure on an Optical Fiber Surface, and Method of Manufacture* was filed on 30 March 1994, with the assistance of Brumbaugh, Graves, Donohue, and Raymond of New York. The patent application covers electronic and electrooptic structures fabricated on an optical fiber as part of this program.

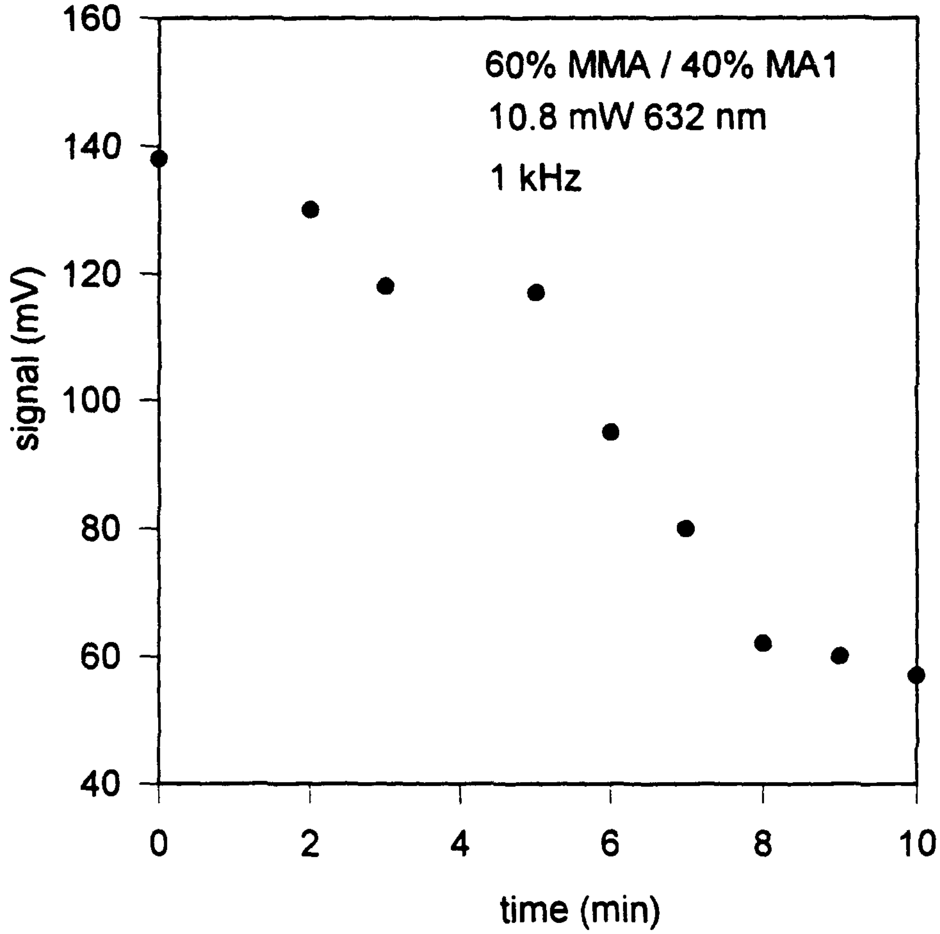

Fig. 1 Electrooptic signal degradation as a function of time due to high visible light intensity. The incident optical power was approximately 10.8 mW of 632 HeNe laser output. The material was a PMMA:MA1 copolymer poled in the usual manner and capped with a UV curable photopolymer to prevent breakdown during the poling process. The fact that the material could not be repoled suggests a thermal or photo-assisted decomposition of the material.